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Description

[0001] The invention relates to materials and techniques relating to security printing.

[0002] The present invention in its broadest sense is concerned with the provision of security in relation to documents, vouchers, packaged goods and tokens of value. Examples of these are banknotes, cheques and drafts, bond and stock certificates, and credit and bank cards. All of these are referred to hereinafter for simplicity as "documents".

[0003] Documents of this nature have the requirement to be as secure as possible against forgery and falsification and for this purpose it is desirable that they exhibit both covert and overt security features. The expression "covert security feature" is used to denote some security feature which is not visually apparent to the normal user, whereas "overt security feature" is used to denote a feature which can be readily seen and recognised by members of the public without the use of specialised equipment or confidential information. Traditional forms of overt security features include water marks, metal security threads, and the use of specialised forms of paper and printing.

[0004] Known methods of covert security include NIR and IR absorber inks, magnetic threads, complex optical and electrically conductive indicia, anti-Stokes, visible-wavelength-emitting phosphors etc.

[0005] With rapid advances in reprographic technology such as relatively cheap and high quality colour photocopiers and easily available digital image manipulation; the traditional forms of security have become increasingly easy to circumvent. This is because the absorption and emission in the visible, NIR and IR ranges of all the currently used and proposed security dopants are readily available in the public domain since the current materials were developed for the laser and lamp industries. This is particularly true for all the rare earth containing absorbers and emitters, where many thousands of public domain references of absorption and emission spectra are listed from the 1950's onwards. There is accordingly a requirement for improved forms of both covert and overt security features, preferably ones which can be used with existing printing technology at modest cost.

[0006] WO-A-81 03509 concerns document security markings employing quasiresonant luminescent dopants which emit visible radiation in narrow wavelength ranges close to the wavelengths of the applied excitation light. The dopants may be incorporated in glass fibres or the like embedded into the documents.

[0007] EP-A-0440554 discloses a covert security feature involving two chemical reactants, one of which is incorporated into the document but provides no security features until it is chemically activated by the external application of a second chemical reactant. The authentication process involves the application of the second reactant, yielding a visible inscription on the document.

[0008] EP-A-0202902 relates to security markings that are invisible in visible light but fluoresce under UV light. It is particularly concerned with providing such markings on ceramic articles, by means of materials that will withstand ceramic firing temperatures.

[0009] DE-B-2845401 concerns security "hallmarks" that flouresce under UV light.

[0010] DE-A-2048853 concerns the use of photochromic compounds in order to make documents resistant to photocopying.

[0011] According to one aspect of the present invention, there is provided a method of providing a document with a covert security feature, in which the document is provided with at least one inorganic dopant, the dopant being of a material which can be identified by examination of its visible wavelength absorption spectrum, measured in either reflective or transmissive mode, in response to broad-band visible wavelength photon radiation, in which the dopant is fused with other elements and micronised into a fine powder before being applied to or otherwise incorporated into the document, thereby altering said visible wavelength absorption spectrum of the dopant, and in which the dopant exhibits no UV, visible or IR stimulated output.

[0012] This and other aspects and features of the present invention are defined in the appended claims.

[0013] The present invention will now be described by way of example with reference to the accompanying drawings of which:

Fig. 1 shows a blue ink reflectance spectrum from a paper print;

Fig.2 shows green ink reflectance spectrum from a paper print;

Fig.3 shows red ink reflectance spectrum from a paper print;

Fig.4 shows a reflectance spectrum from the Praesodymium Oxide dopant in accordance with the present invention;

Fig.5 shows a reflectance spectrum from the Neodymium Oxide dopant in accordance with the present invention;

Fig.6 shows a reflectance spectrum from the Holmium Oxide dopant in accordance with the present invention;

Fig.7 shows a reflectance spectrum from the Thulium Oxide dopant in accordance with the present invention;

Fig.8 shows a reflectance spectrum of raw Europium Oxide powder as used in the present invention;

Fig.9 shows a reflectance spectrum of the same Europium Oxide contained in glass;

Fig.10 shows a reflectance spectrum of raw Erbium Oxide powder as used in the present invention;

Fig.11 shows a reflectance spectrum of the same Erbium Oxide contained in glass;

[0014] The present invention provides a range of inorganic dopants designed with absorption spectra sufficiently different in form and structure from the absorption spectra of printing inks so that the dopants can be easily identified. They thus become very covert because they exhibit no UV, visible or IR stimulated output to be observed by a counterfeiter.

[0015] The preferred elements (or oxides or salts thereof) for our dopants are fused with other elements in order to hide the presence of the dopant element, or to alter its absorption spectrum and when micronised into a fine powder can be mixed into, for example, a printing ink or a batch composition for plastics production etc. When the dopant is mixed with other elemental compounds and where one of its admixture compounds contains a substantial proportion by weight of a particular range of atomic number (z) elements, varying the proportion of this compound in the final mix can vary the absorption spectrum of the final inorganic mixture, thus essentially creating further dopants.

[0016] The present invention depends on the incorporation of a synthesised inorganic dopant into or onto the document at any stage of its manufacture, including the printing stage. These dopants are designed to have very complex visible wavelength absorption spectra, measured in either reflective or transmissive mode. The spectra they exhibit are <u>not</u> found in printing inks or common marbling substrates. This results in high signal-to-noise ratio detection, and hence the ability to identify the dopant in 10msec or less using low output (c. 4W) bulbs as illuminants.

[0017] The dopant incorporation with its unique spectrographic pattern gives independence from document soiling, wear and tear etc, because it allows excellent signal-to-noise ratio. Pattern recognition software to identify, within 1 msec, the complex signature of our synthesised dopants is readily available from suppliers in the public domain, having been used in optical and nuclear spectrometry for 30 years. Dopants in accordance with the present invention can be incorporated singly, mixed, or in separate areas to produce a "bar code", or to simply confuse a forger. The dopants, depending on composition, are either colourless or transparent, or coloured, at the choice of the user. Dopants made in accordance with the present invention provide high optical absorption yet give optical transparency because their absorption features are created at wavelengths to which the human eye is insensitive.

[0018] For visible wavelength interpretation the preferred method is to illuminate an area of at least 5mm^2 by a ring of at least 6-8 200μm optical fibres in a concentric ring, and channel reflected light through an inner 200μm optical fibre to the wavelength detector. It has been found that this number of optical fibres gives sufficient signal for interpretation of the spectra, however the present invention is not limited to this method of detection of the spectrum or the number or arrangement of optical fibres used in this detection method. This eliminates the optical losses due to lenses in much prior art, which in turn leads to the processing speed of our system. CCD based wavelength detectors, followed by A-D conversion for processing are standard technologies in public domain electronics. Our dopants are engineered to give no visible signal, such as fluorescence, upon illumination by UV, visible, or IR radiation and are hence not easily replicated as has happened with fluorescent inks, and other emitting technologies.

[0019] The advantages of the present invention will be readily apparent when the spectra obtained from these dopants is compared with those obtained from standard printing inks, or colourisers in plastics etc. The standard inks and the like give relatively unsophisticated reflectance spectra - see for example Figures 1, 2, 3. These show the visible reflectance spectrum of a Pantone standard blue, green and red ink from a paper print. Figures 4, 5, 6, 7 show the visible reflectance spectra from the four dopants, Praesodymium Oxide, the Neodymium Oxide, the Holmium Oxide and Thulium Oxide, incorporated in a clear litho varnish and printed on the same paper as that used to obtain the spectra shown in Figs. 1, 2 and 3.

[0020] The prints obtained using dopants in accordance with the present invention are completely colourless to the eye. Figure 4 for example, shows many easily identifiable peaks, troughs and turning points in its spectrum with a shape easily distinguished from any ink or colouring dopants. It is these unique features which give the excellent signal-to-noise ratio, giving the rapid identification ability of our system, with excellent identification rates, and very low false acceptances, together with high rejection for forged copies.

[0021] The features, and/or slopes, of the reflectance spectra can be shifted to create other dopants by incorporating the dopants into inorganic compounds of the type described later.

[0022] The use of visible wavelength spectrometry, as opposed to IR or NIR wavelengths, makes possible many more commercial applications. This is firstly because of the reduced cost of components for the visible, and secondly

because the cheapest excitation source is a common (4W) torch bulb which emits plenty of visible light but very little IR. Hence IR and NIR techniques require more powerful and costly excitation sources. Also by moving to the visible we make it easy to construct simple hand-held portable instrumentation which again increases possible commercial applications.

[0023] Visible wavelength spectroscopy as revealed in the prior art with application to security uses lenses or mirrors and lamps to provide the illumination source.

[0024] Many suppliers, such as Oriel Corp. USA, now make commercially available reflectance probes which are about 6mm diameter overall and contain a ring of illuminating fibres (200µ diameter 6-8 in number) surrounding a centre core of detecting fibres. Use of these probes gives much improved signal-to-noise ratio at the CCD array, or Si photodiode array, or other detector. Using other off-the-shelf components the output of the array spectrometer can be coupled to D-A converters and operated from a laptop, hand-held palmtop, or desktop PC computers. This can easily be interfaced to standard computer software on production lines for authentication at high speed - 10m/sec.

[0025] The dopants we have identified as working well can be added to standard offset litho printing inks in a manner known to those skilled in the art. It is added in quantities up to about 30% by volume without affecting the printing process, providing the dopants have been micronised into fine powders of the order of 1-4µm diameter. If this step is omitted poor uniformity printing results. Our dopants need add no colour to the ink, so give a colourless invisible printed strip onto the object to be protected. Alternatively a colouring dopant can be selected to blend in with an existing coloured scheme.

[0026] A major advantage of the dopants made in accordance with the present invention is that they are cheap and simple, not requiring the presence of complex expensive chemicals.

[0027] The dopants can be applied to artefacts by any standard deposition technique - air spray, lacquering, printing, stamping.

[0028] The dopants could also be directly incorporated into paper or plastic (for example) at time of manufacture of said paper or plastic. For our techniques to work it is not necessary that the dopants are added as a superior layer or film, although in many cases this will be the simplest and cheapest method. The fact that our dopant/excitation/detector technology does not require surface deposition can offer more security/covertness to the process. It arises because the excitation methods we are employing have ranges of many tens of microns in common materials such as paper and plastics. Since dopants in accordance with the present invention need <u>not</u> be on the surface of the document the forger is denied the opportunity to scrape off samples from repeated small surface areas and analyse them to look for "surprising" changes in composition from area to area. Such changes give the forger a clue that covert technology is being used in that area.

The multiple peaks, troughs, and turning points resulting give rapid, positive, unambiguous identification of dopant presence (and hence object authenticity) and allow multiple dopants to be used as a further method of disguise, if required.

[0029] It has been found that the most useful compounds (those with the most distinctive absorption spectra in the visible) are formed by fusion melting. Silicates, phosphates, borates have been found to be the most useful starting points for fusion, because they give transparent glass matrices.

[0030] In forming the required solids for powdering, the chemical batch composition is not, for example, limited to that required to produce, say, a glass. This is because long range atomic order is not required in the solid, since homogeneity is assured by micronising the composition. Indeed in general terms we have found that the best compositions are obtained where phase separation of the melt temperature is imminent. This point is determined experimentally for each composition. Nor need the chemistry be limited to stoichometric ratios such as to arrive at crystalline compounds, e.g. as used to produce the commonplace inorganic fluorescence powders added to printing inks.

[0031] In many compositions, the structure and magnitude of the absorption peaks can be controlled over a wide range by control of the gas atmosphere during the melt phase. This is established by trial and error for each composition by test melting each composition in air, in a reducing atmosphere, and in an oxidising atmosphere to determine the optimum methodology and conditions for the absorption profile required.

[0032] In many compositions, the structure and magnitude of absorption peaks can be controlled by including a substantial quantity (>20% by weight) of a high atomic number Z element in the batch composition (lanthanum, bismuth, and strontium work well, as examples). Then varying the content of this high Z element only gives changes in position and magnitude of the absorption peaks, from composition to composition. Different absorption peak wavelengths and magnitudes from that exhibited by the raw dopant before being incorporated in a glass.

[0033] The effect of incorporating the dopant in a glass on its spectrum can be seen in Figs. 8, 9, 10 and 11.

[0034] Fig. 8 shows a plot of the percent transmission against wavelength (nm) for a raw Europium Oxide dopant powder. Fig.9 shows a plot of the percent transmission against wavelength (nm) for a Europium Oxide dopant powder incorporated in a glass and ground into a fine powder. The substances contained in the glass are as given in Table 1 below and the glass plus dopant is made in accordance with the method given below Table 1.

[0035] Simply from a visual inspection it can be seen that the two spectra are very different.

The feature of the spectrum of Europium Oxide shown at reference numeral 81 for the raw oxide powder that occurs at a wavelength of 533 nm has been shifted to 531nm. A similar shift can be seen for the lower wavelength peaks 83 and 93. In both cases, the shift in wavelength was 2nm. The most significant difference between the spectra of Fig. 8 and Fig.9 is the presence of the line in the spectrum of the Europium Oxide contained in glass at 393nm. There is no similar line in the raw powder spectrum.

[0036] Fig. 10 shows a plot of the percent transmission against wavelength (nm) for a raw Erbium Oxide dopant powder. Fig.11 shows a plot of the percent transmission against wavelength (nm) for an Erbium Oxide dopant powder incorporated in a ground fine powder glass. As with the sample used to obtain the spectrum if Fig.9, the substances contained in the glass are as given in Table 1 below and the glass plus dopant is made in accordance with the method given below Table 1.

[0037] Fig. 10 shows, at reference numeral 101, the existence of multiple peak structure occurring from a minimum point at 654nm to approximately 700nm. It can be seen that these features are absent from the spectrum of Fig. 11 as indicated at reference numeral 111.

[0038] Fig.10 also has multiple peak structure occurring from a minimum value at 521nm up to approximately 600nm. These features are absent from the spectrum of Fig. 11 as can be seen at reference numeral 113.

[0039] We have shown our dopant technology to work in a wide variety of compounds, including, but not limited to, silicates, borosilicates, borates and germanates.

[0040] The following are a number of examples of the composition and method of manufacture of a doped glass in accordance with the present invention.

Example 1

[0041] A glass batch of a typical suitable composition is as follows.

Table 1

Compound	Wt %
SiO_2	35%
B_2O_3	40.0
Na_2O	8.5
K_2O	8.5
Al_2O_3	1.0
MgO	4.0

[0042] To this batch was added 0.1 to 25 wt% of Eu_2O_3. All powder sizes can be used but approximately 250 mesh is preferable. A wide range of crucibles can be used, a Platinum crucible was used in this case. The final batch is mixed and homogenised then it is added to the crucible heated to 845°C. The temperature is then increased at a rate of approximately 5 °C/min to 1200 °C the final melt temperature. It has been found that good quality melts are produced by holding the melt at the final temperature for between 2 and 2.5 hours before powdering the glass. For absorber products not visible to the naked eye, the natural emissions of Eu_2O_3 may be quenched by the use of high concentrations of Eu_2O_3 or by the inclusion of small < 1% quantities of nickel oxide, silver oxide or lead oxide as luminescence quenchers.

[0043] The following compositions may also be used

Table 2

Compound	Wt (g)	Compound	Wt (g)	Compound	Wt (g)
SiO_2	55	SiO_2	70	SiO_2	50
B_2O_3	65	B_2O_3	80	Be_2CO_3	20
Na_2CO_3	29	Na_2CO_3	29	$SrCO_3$	20
K_2CO_3	20	K_2CO_3	20	Na_2CO_3	10
Li_2CO_3	5	Li_2CO_3	5	K_2CO_3	10
Al_2O_3	2	Al_2O_3	2	Li_2CO_3	5

Table 2 (continued)

Compound	Wt (g)	Compound	Wt (g)	Compound	Wt (g)
MgO	8	MgO	5	Al_2O_3	2
				MgO	5

Table 3

Compound	Wt (g)	Compound	Wt (g)
SiO_2	35	SiO_2	55
B_2O_3	80	B_2O_3	65
Be_2CO_3	40	Na_2CO_3	29
Na_2CO_3	29	K_2CO_3	20
K_2CO_3	20	Li_2CO_3	5
Li_2CO_3	5	Al_2O_3	2
Al_2O_3	2	MgO	8
MgO	8		

[0044] Another suitable composition is of the type

Table 4

Compound	Wt %
SiO_2	51
B_2O_3	13
Al_2O_3	8
MgO	6
CaO	10
SrO	4
ZnO	4

[0045] This is particularly suitable as a base for incorporating dopants for visible wavelength absorption detection because all the base elements have largely unfeatured absorption spectra.

[0046] Dopants have also been successfully incorporated into glass matrices with the following ranges of chemical composition.

30-56wt% SiO_2,
5-35wt%, $La_2O_3/Bi_2O_3/Sr_2O_3$,
2-33wt% $Li_2O/K_2O/Na_2O$,
0-6% Al_2O_3
wherein the La, Bi, Sr are examples of a suitable high Atomic number component.

[0047] Incorporation of all three alkaline earth compounds, plus BaO, gives much reduced melting temperatures.

[0048] Preferred elements for dopant fabrication for visible wavelength absorption system

Table 5

Barium	Zinc
Lanthanum Lead Magnesium Strontium	Samarium Praesodymium Europium Boron-10

Table 5 (continued)

Barium	Zinc
Titanium	Neodymium
Chromium	Holmium
Iron	Thulium
Caesium	Cadmium
Molybdemum	Antimony
Nickel	Erbium
Tungsten	Lutecium
Cobalt	Tin
Sodium	
Potassium	
Terbium	

[0049] Improvements and modifications may be incorporated without deviating from the scope of the invention.

Claims

1. A method of providing a document with a covert security feature in which the document is provided with at least one inorganic dopant, the dopant being of a material which can be identified by examination of its visible wavelength absorption spectrum, measured in either reflective or transmissive mode, in response to broad-band visible wavelength photon radiation, in which the dopant is fused with other elements and micronised into a fine powder before being applied to or otherwise incorporated into the document, thereby altering said visible wavelength absorption spectrum of the dopant, and in which the dopant exhibits no UV, visible or IR stimulated output.

2. A method of providing a document with a covert security feature as claimed in claim 1, in which the dopant comprises one or more inorganic compounds.

3. A method of providing a document with a covert security feature as claimed in claim 1 or claim 2, in which the dopant comprises one of, or a combination of the elements listed in Table 5, in elemental form or as an oxide or salt.

4. A method of providing a document with a covert security feature as claimed in any preceding claim, in which the dopant is mixed with a quantity of an element or its salt or its oxide with an atomic number greater than 36.

5. A method of providing a document with a covert security feature as claimed in claim 4, in which the element or its salt or its oxide is Strontium, Lanthanum or Bismuth.

6. A method of providing a document with a covert security feature as claimed in any preceding claim, in which the dopant is mixed with ink and the resulting mixture is applied to the document.

7. A method of providing a document with a covert security feature as claimed in any preceding claim, in which the dopant is fused in a glass.

8. A method of providing a document with a covert security feature as claimed in claim 7, in which the glass is made of silicates and/or phosphates and/or borates.

9. A method of providing a document with a covert security feature as claimed in any preceding claim, in which each particle of the micronised fine powder has a diameter of 1-4 μm.

10. A method of providing a document with a covert security feature as claimed in any preceding claim, in which the dopant is such that, when the document is illuminated with broad-band visible light to produce a reflectance spectrum with frequency components generated by the dopant and by other reflecting substances contained in the document, said spectrum contains minimal frequency overlap between the components of the spectrum generated by the dopant and that part of the spectrum generated by other substances contained in the document.

11. A method of providing a document with a covert security feature as claimed in any preceding claim, in which the dopant is such that, when the document is illuminated with broad-band visible light the absorption features of said visible wavelength absorption spectrum are created at wavelengths to which the human eye is insensitive.

12. A method of providing a document with a covert security feature as claimed in any preceding claim, in which said visible wavelength absorption spectrum of the dopant can be shifted to a higher or lower wavelength.

13. A method of providing a document with a covert security feature as claimed in any preceding claim, in which said visible wavelength absorption spectrum of the dopant can be shifted to a higher or lower wavelength by alteration of the composition of a glass in which it is fused.

14. A method of providing a document with a covert security feature as claimed in any preceding claim, in which the dopant is fused in a glass and in which said visible wavelength absorption spectrum of the dopant is alterable by alteration of the reaction temperature and/or pressure at which the glass is made.

15. A document provided with a covert security feature by the method of any of the preceding claims.

16. A dopant for use in providing a document with a covert security feature, comprising one or a combination of the elements listed in table 5, in elemental form or as an oxide or salt, which can be identified by examination of its visible wavelength absorption spectrum, measured in either reflective or transmissive mode, in response to broad-band visible wavelength photon radiation, fused with other elements and micronised into a fine powder, thereby altering said visible wavelength absorption spectrum of the dopant, and which dopant exhibits no UV, visible or stimulated output.

17. A method of making a dopant as claimed in claim 16, in which said one or a combination of the elements listed in Table 5, in elemental form or as an oxide or salt, is fused in a glass and subsequently micronised.

Patentansprüche

1. Ein Verfahren zur Bereitstellung eines Dokuments mit einem verborgenen Sicherheitsmerkmal, wobei das Dokument mit mindestens einem anorganischen Dotierungsmittel bereitgestellt ist, wobei das Dotierungsmittel aus einem Material ist, das durch die Untersuchung seines sichtbaren Wellenlängenabsorptionsspektrums, welches in entweder reflektivem oder übertragbarem Mode gemessen wird, als Reaktion auf breitbandige, sichtbare Wellenlängenphotonenstrahlung, identifiziert werden kann, wobei das Dotierungsmittel mit anderen Elementen verschmolzen und zu einem feinen Pulver mikronisiert wird, bevor es auf das Dokument aufgetragen oder anderweitig in dieses inkorporiert wird, wodurch das sichtbare Wellenlängenabsorptionsspektrum des Dotierungsmittels verändert wird, und wobei das Dotierungsmittel keine UV-, sichtbare oder IR stimulierte Ausgabe vorzeigt.

2. Verfahren zur Bereitstellung eines Dokuments mit einem verborgenen Sicherheitsmerkmal gemäß Anspruch 1, wobei das Dotierungsmittel eine oder mehrere anorganische Verbindungen beinhaltet.

3. Verfahren zur Bereitstellung eines Dokuments mit einem verborgenen Sicherheitsmerkmal gemäß Anspruch 1 oder Anspruch 2, wobei das Dotierungsmittel eines der in Tabelle 5 aufgelisteten Elemente oder eine Kombination aus diesen in elementarer Form oder als ein Oxid oder Salz beinhaltet.

4. Verfahren zur Bereitstellung eines Dokuments mit einem verborgenen Sicherheitsmerkmal gemäß einem der vorhergehenden Ansprüche, wobei das Dotierungsmittel mit einer Menge eines Elements oder seinem Salz oder seinem Oxid mit einer Atomnummer, die größer als 36 ist, vermischt ist.

5. Verfahren zur Bereitstellung eines Dokuments mit einem verborgenen Sicherheitsmerkmal gemäß Anspruch 4, wobei das Element oder sein Salz oder sein Oxid Strontium, Lanthan oder Bismut ist.

6. Verfahren zur Bereitstellung eines Dokuments mit einem verborgenen Sicherheitsmerkmal gemäß einem der vorhergehenden Ansprüche, wobei das Dotierungsmittel mit Tinte vermischt ist und die anfallende Mischung auf das Dokument aufgetragen wird.

7. Verfahren zur Bereitstellung eines Dokuments mit einem verborgenen Sicherheitsmerkmal gemäß einem der vor-

hergehenden Ansprüche, wobei das Dotierungsmittel in einem Glas verschmolzen ist.

8. Verfahren zur Bereitstellung eines Dokuments mit einem verborgenen Sicherheitsmerkmal gemäß Anspruch 7, wobei das Glas aus Silikaten und/oder Phosphaten und/oder Boraten hergestellt ist.

9. Verfahren zur Bereitstellung eines Dokuments mit einem verborgenen Sicherheitsmerkmal gemäß einem der vorhergehenden Ansprüche, wobei jedes Partikel des mikronisierten feinen Pulvers einen Durchmesser von 1 - 4 µm aufweist.

10. Verfahren zur Bereitstellung eines Dokuments mit einem verborgenen Sicherheitsmerkmal gemäß einem der vorhergehenden Ansprüche, wobei das Dotierungsmittel derart ist, dass beim Beleuchten des Dokuments mit breitbandigem sichtbarem Licht zur Erzeugung eines Reflexionsspektrums mit Frequenzkomponenten, die durch das Dotierungsmittel und durch andere reflektierende in dem Dokument enthaltene Substanzen generiert werden, das Spektrum eine minimale Frequenzüberlappung zwischen den Komponenten des Spektrums, welche durch das Dotierungsmittel generiert werden, und jenem Teil des Spektrums, der durch andere in dem Dokument enthaltene Substanzen generiert wird, enthält.

11. Verfahren zur Bereitstellung eines Dokuments mit einem verborgenen Sicherheitsmerkmal gemäß einem der vorhergehenden Ansprüche, wobei das Dotierungsmittel derart ist, dass beim Beleuchten des Dokuments mit breitbandigem sichtbarem Licht die Absorptionsmerkmale des sichtbaren Wellenlängenabsorptionsspektrums bei Wellenlängen kreiert werden, gegenüber denen das menschliche Auge unempfindlich ist.

12. Verfahren zur Bereitstellung eines Dokuments mit einem verborgenen Sicherheitsmerkmal gemäß einem der vorhergehenden Ansprüche, wobei das sichtbare Wellenlängenabsorptionsspektrum des Dotierungsmittels auf eine höhere oder tiefere Wellenlänge verschoben werden kann.

13. Verfahren zur Bereitstellung eines Dokuments mit einem verborgenen Sicherheitsmerkmal gemäß einem der vorhergehenden Ansprüche, wobei das sichtbare Wellenlängenabsorptionsspektrum des Dotierungsmittels auf eine höhere oder tiefere Wellenlänge verschoben werden kann, indem die Zusammensetzung eines Glases, in dem es verschmolzen ist, verändert wird.

14. Verfahren zur Bereitstellung eines Dokuments mit einem verborgenen Sicherheitsmerkmal gemäß einem der vorhergehenden Ansprüche, wobei das Dotierungsmittel in einem Glas verschmolzen ist, und wobei das sichtbare Wellenlängenabsorptionsspektrum des Dotierungsmittels änderbar ist, indem die Reaktionstemperatur und/oder der Druck, bei dem das Glas hergestellt wird, verändert wird.

15. Ein Dokument, das durch das Verfahren gemäß einem der vorhergehenden Ansprüche mit einem verborgenen Sicherheitsmerkmal bereitgestellt ist.

16. Ein Dotierungsmittel zur Verwendung bei der Bereitstellung eines Dokuments mit einem verborgenen Sicherheitsmerkmal, das eines der in Tabelle 5 aufgelisteten Elemente oder eine Kombination aus diesen in elementarer Form oder als ein Oxid oder Salz, das durch die Untersuchung seines sichtbaren Wellenlängenabsorptionsspektrums, welches in entweder reflektivem oder übertragbarem Mode gemessen wird, als Reaktion auf breitbandige, sichtbare Wellenlängenphotonenstrahlung identifiziert werden kann, das mit anderen Elementen verschmolzen und zu einem feinen Pulver mikronisiert wird, wodurch das sichtbare Wellenlängenabsorptionsspektrum des Dotierungsmittels verändert wird, und wobei das Dotierungsmittel keine UV-, sichtbare oder IR stimulierte Ausgabe vorzeigt, beinhaltet.

17. Ein Verfahren zur Herstellung eines Dotierungsmittels gemäß Anspruch 16, wobei das eine der in Tabelle 5 aufgelisteten Elemente oder eine Kombination aus diesen, in elementarer Form oder als ein Oxid oder Salz, in einem Glas verschmolzen und anschließend mikronisiert wird.

Revendications

1. Un procédé pour fournir une caractéristique de sécurité cachée à un document dans lequel le document est pourvu d'au moins un dopant inorganique, le dopant étant en un matériau pouvant être identifié grâce à l'examen de son spectre d'absorption de longueur d'onde visible, mesuré soit en mode réflectif, soit en mode transmissif, en réponse

à un rayonnement photonique de longueur d'onde visible à large bande, dans lequel le dopant est amalgamé à d'autres éléments et micronisé en une fine poudre avant d'être appliqué à ou autrement incorporé dans le document, modifiant de cette façon ledit spectre d'absorption de longueur d'onde visible du dopant, et dans lequel le dopant ne présente pas de sortie stimulée par rayonnements ultraviolet, visible ou infrarouge.

2. Un procédé pour fournir une caractéristique de sécurité cachée à un document tel que revendiqué dans la revendication 1, dans lequel le dopant comporte un ou plusieurs composés inorganiques.

3. Un procédé pour fournir une caractéristique de sécurité cachée à un document tel que revendiqué dans la revendication 1 ou la revendication 2, dans lequel le dopant comporte l'un des éléments listés dans le Tableau 5 ou une combinaison de ceux-ci, sous forme élémentaire ou sous forme oxyde ou sel.

4. Un procédé pour fournir une caractéristique de sécurité cachée à un document tel que revendiqué dans n'importe quelle revendication précédente, dans lequel le dopant est mélangé à une quantité d'un élément ou son sel ou son oxyde dont le numéro atomique est supérieur à 36.

5. Un procédé pour fournir une caractéristique de sécurité cachée à un document tel que revendiqué dans la revendication 4, dans lequel l'élément ou son sel ou son oxyde est le Strontium, le Lanthane ou le Bismuth.

6. Un procédé pour fournir une caractéristique de sécurité cachée à un document tel que revendiqué dans n'importe quelle revendication précédente, dans lequel le dopant est mélangé à de l'encre et le mélange résultant est appliqué sur le document.

7. Un procédé pour fournir une caractéristique de sécurité cachée à un document tel que revendiqué dans n'importe quelle revendication précédente, dans lequel le dopant est amalgamé dans un verre.

8. Un procédé pour fournir une caractéristique de sécurité cachée à un document tel que revendiqué dans la revendication 7, dans lequel le verre est réalisé en silicates et/ou phosphates et/ou borates.

9. Un procédé pour fournir une caractéristique de sécurité cachée à un document tel que revendiqué dans n'importe quelle revendication précédente, dans lequel chaque particule de la fine poudre micronisée a un diamètre de 1 à 4 µm.

10. Un procédé pour fournir une caractéristique de sécurité cachée à un document tel que revendiqué dans n'importe quelle revendication précédente, dans lequel le dopant est tel que, lorsque le document est illuminé avec de la lumière visible à large bande pour produire un spectre de réflectance avec des composants de fréquences générés par le dopant et par d'autres substances réfléchissantes contenues dans le document, ledit spectre contient un recouvrement de fréquences minimal entre les composants du spectre générés par le dopant et la partie du spectre générée par d'autres substances contenues dans le document.

11. Un procédé pour fournir une caractéristique de sécurité cachée à un document tel que revendiqué dans n'importe quelle revendication précédente, dans lequel le dopant est tel que, lorsque le document est illuminé avec de la lumière visible à large bande, les caractéristiques d'absorption dudit spectre d'absorption de longueur d'onde visible sont créées à des longueurs d'onde auxquelles l'oeil humain est insensible.

12. Un procédé pour fournir une caractéristique de sécurité cachée à un document tel que revendiqué dans n'importe quelle revendication précédente, dans lequel ledit spectre d'absorption de longueur d'onde visible du dopant peut être passé à une longueur d'onde plus haute ou plus basse.

13. Un procédé pour fournir une caractéristique de sécurité cachée à un document tel que revendiqué dans n'importe quelle revendication précédente, dans lequel ledit spectre d'absorption de longueur d'onde visible du dopant peut être passé à une longueur d'onde plus haute ou plus basse par modification de la composition d'un verre dans lequel il est amalgamé.

14. Un procédé pour fournir une caractéristique de sécurité cachée à un document tel que revendiqué dans n'importe quelle revendication précédente, dans lequel le dopant est amalgamé dans un verre et dans lequel ledit spectre d'absorption de longueur d'onde visible du dopant est modifiable par modification de la température de réaction et/ou de la pression à laquelle le verre est fait.

15. Un document auquel est foumi une caractéristique de sécurité cachée selon le procédé de n'importe lesquelles des revendications précédentes.

16. Un dopant destiné à être utilisé pour foumir une caractéristique de sécurité cachée à un document, comportant l'un des éléments listés dans le Tableau 5 ou une combinaison de ceux-ci, sous forme élémentaire ou sous forme oxyde ou sel, pouvant être identifié grâce à l'examen de son spectre d'absorption de longueur d'onde visible, mesuré soit en mode réflectif, soit en mode transmissif, en réponse à un rayonnement photonique de longueur d'onde visible à large bande, amalgamé à d'autres éléments et micronisé en une fine poudre, modifiant de cette façon ledit spectre d'absorption de longueur d'onde visible du dopant, et lequel dopant ne présente pas de sortie stimulée par rayonnements ultraviolet, visible ou infrarouge.

17. Un procédé pour faire un dopant tel que revendiqué dans la revendication 16, dans lequel ledit élément des éléments listés dans le Tableau 5, ou une combinaison de ceux-ci, sous forme élémentaire ou sous forme oxyde ou sel, est amalgamé dans un verre et par la suite micronisé.

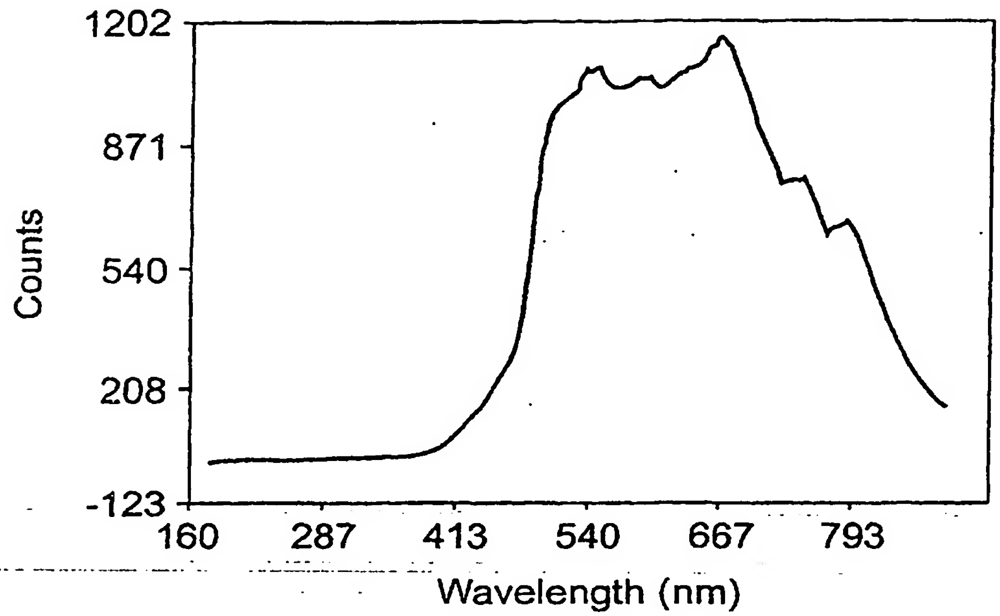
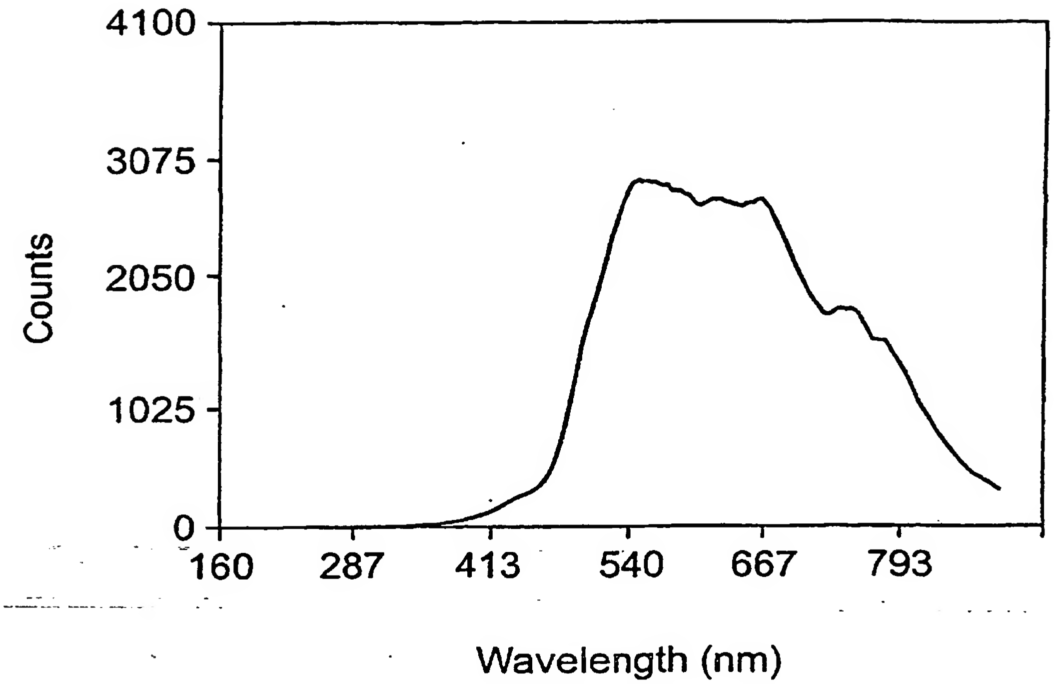

1202
871
540
208
-123
Counts
160
287
413
540
667
793
Wavelength (nm)

Fig. 1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3075
2050
1025
0
Counts
160
287
413
540
667
793
Wavelength (nm)

Fig. 2

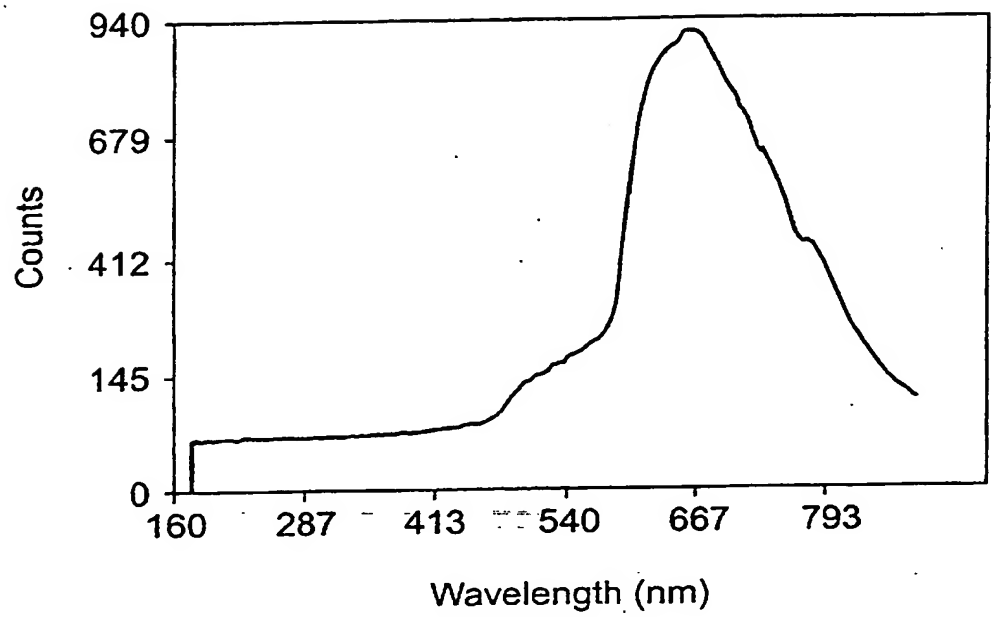

Fig. 3

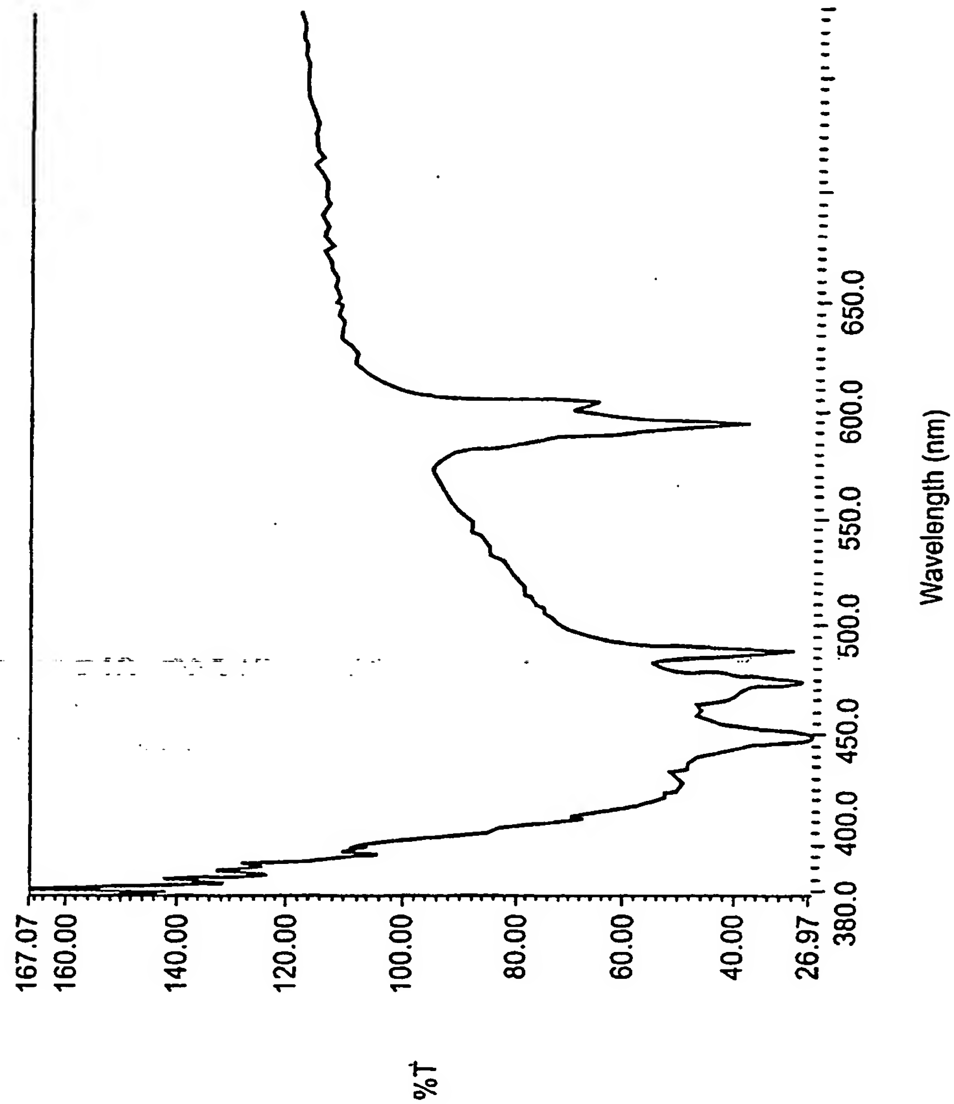
167.07
160.00
140.00
120.00
100.00
80.00
60.00
40.00
26.97
%T
380.0
400.0
450.0
500.0
550.0
600.0
650.0
Wavelength (nm)

Fig. 4

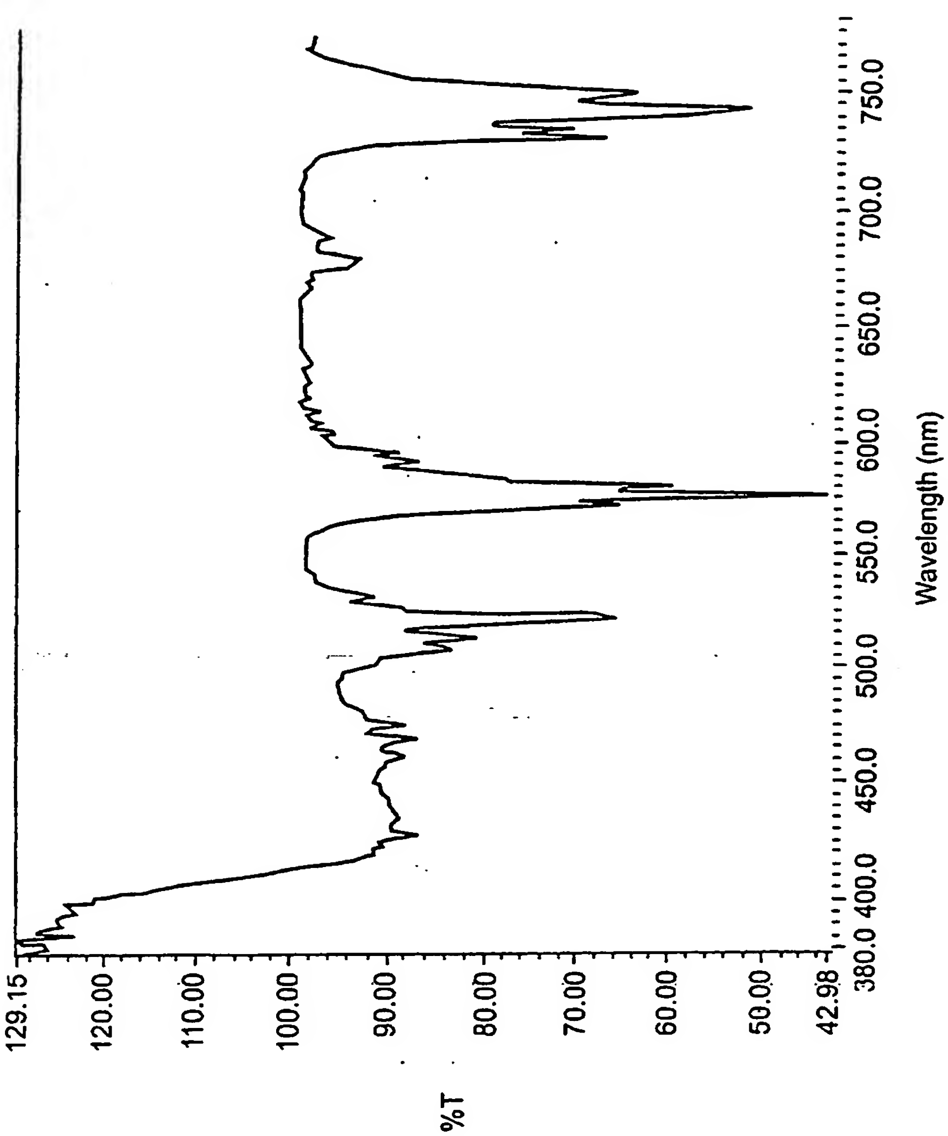
129.15
120.00
110.00
100.00
90.00
80.00
70.00
60.00
50.00
42.98
%T
380.0
400.0
450.0
500.0
550.0
600.0
650.0
700.0
750.0
Wavelength (nm)

Fig. 5

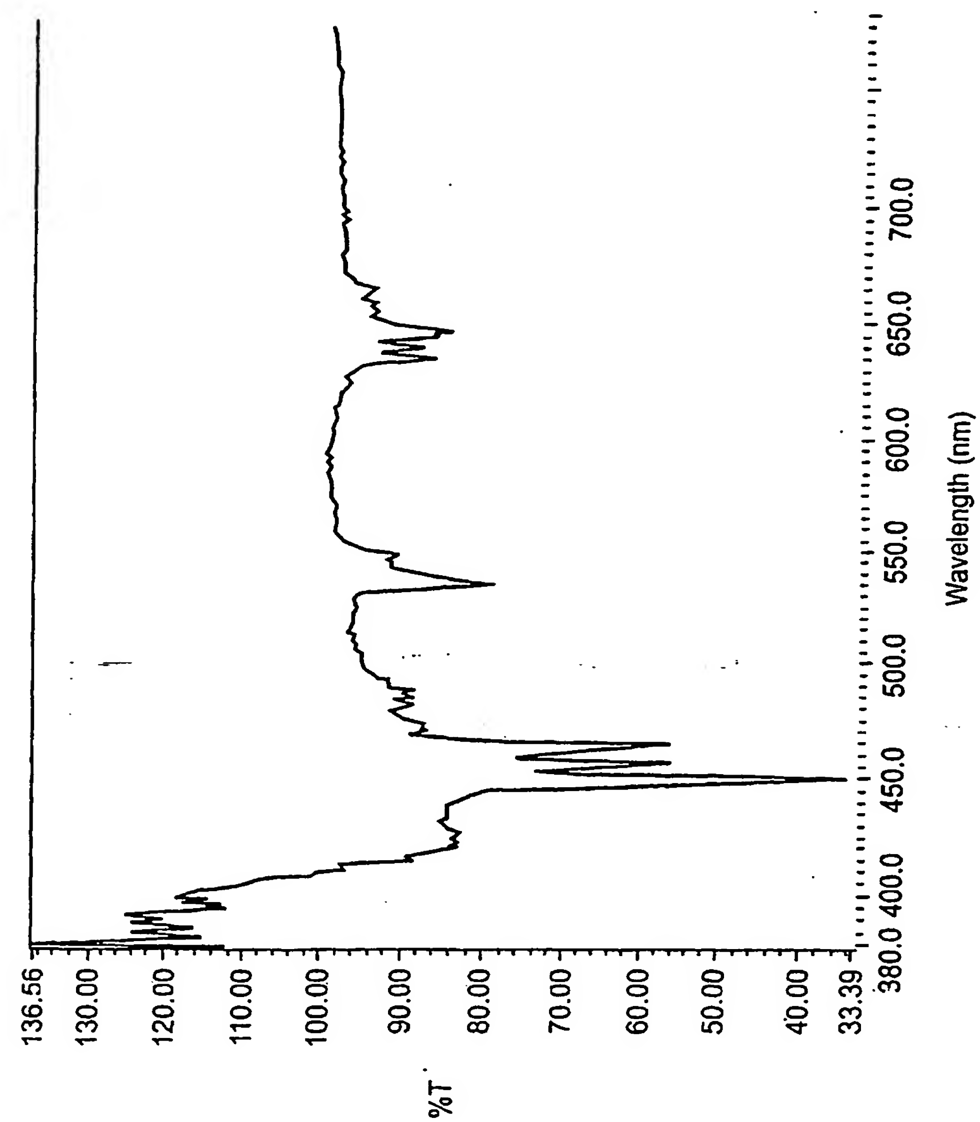
%T
136.56
130.00
120.00
110.00
100.00
90.00
80.00
70.00
60.00
50.00
40.00
33.39
380.0
400.0
450.0
500.0
550.0
600.0
650.0
700.0
Wavelength (nm)

Fig. 6

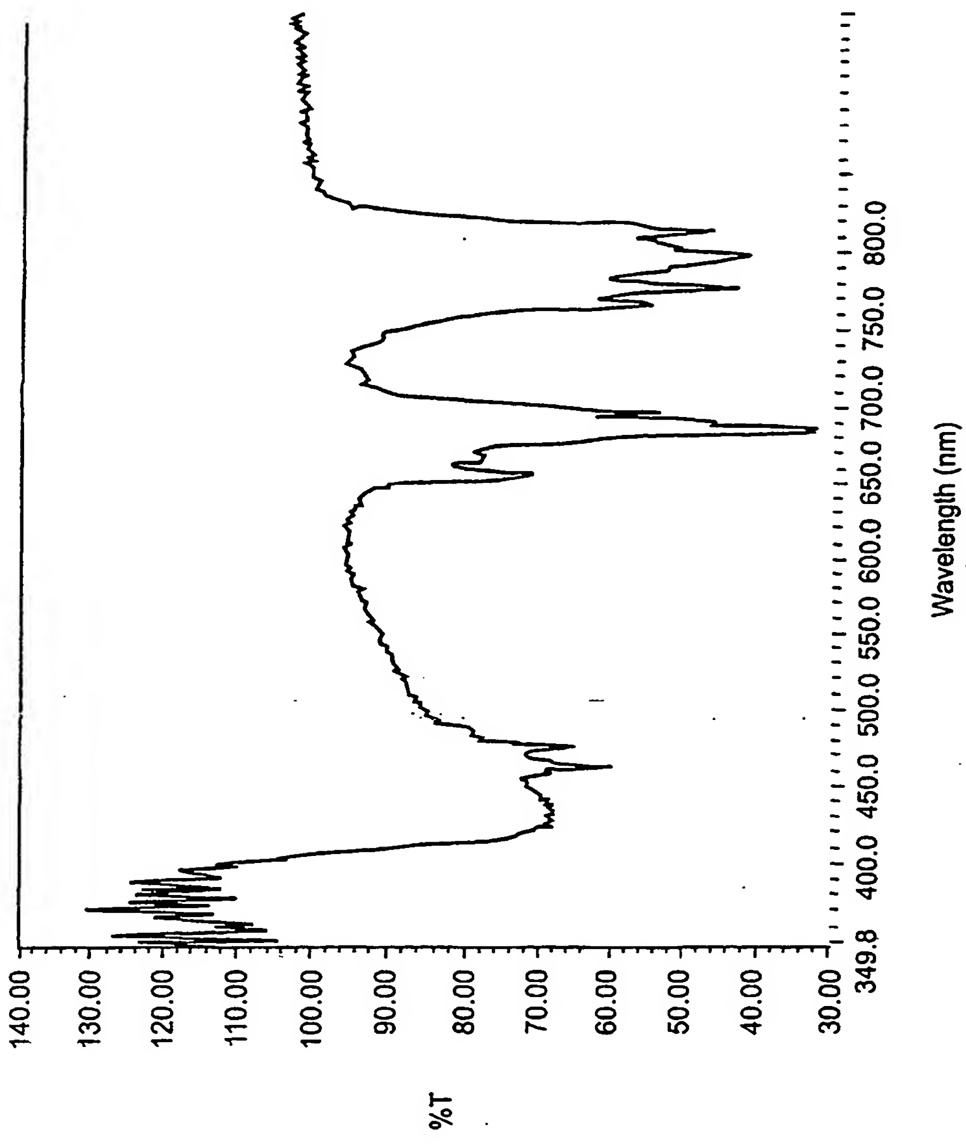
%T
140.00
130.00
120.00
110.00
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
349.8
400.0
450.0
500.0
550.0
600.0
650.0
700.0
750.0
800.0
Wavelength (nm)

Fig. 7

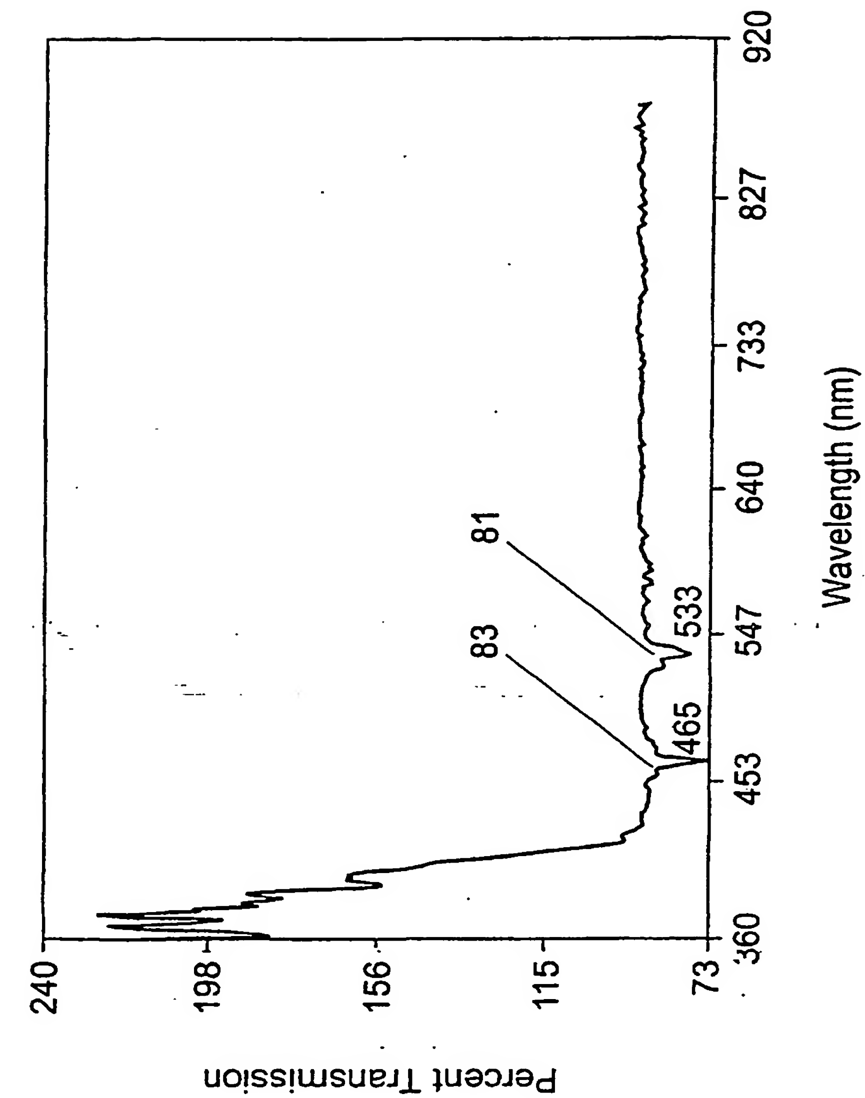
Percent Transmission
240
198
156
115
73
360
453
547
640
733
827
920
Wavelength (nm)
83
81
465
533

Fig. 8

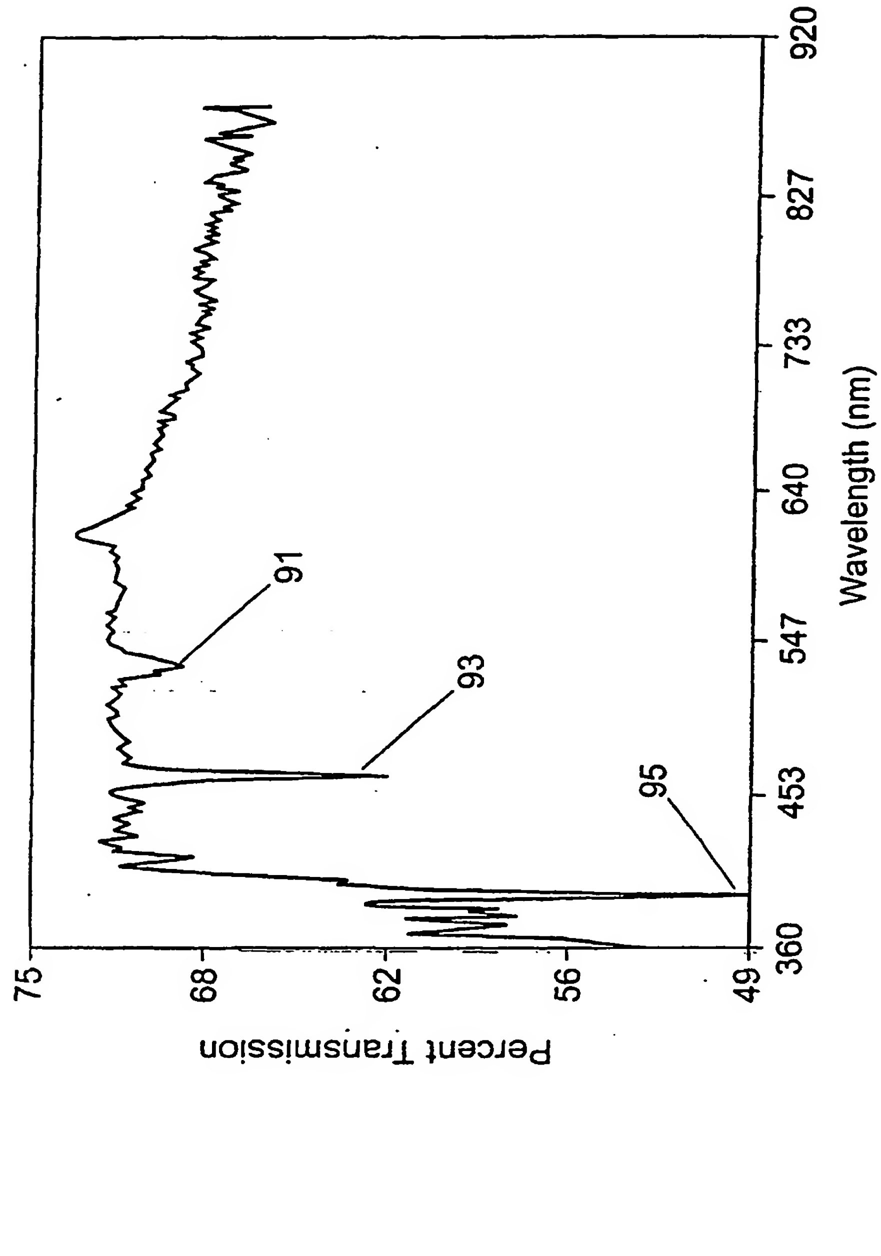
75
68
62
56
49
Percent Transmission
360
453
547
640
733
827
920
Wavelength (nm)
91
93
95

Fig. 9

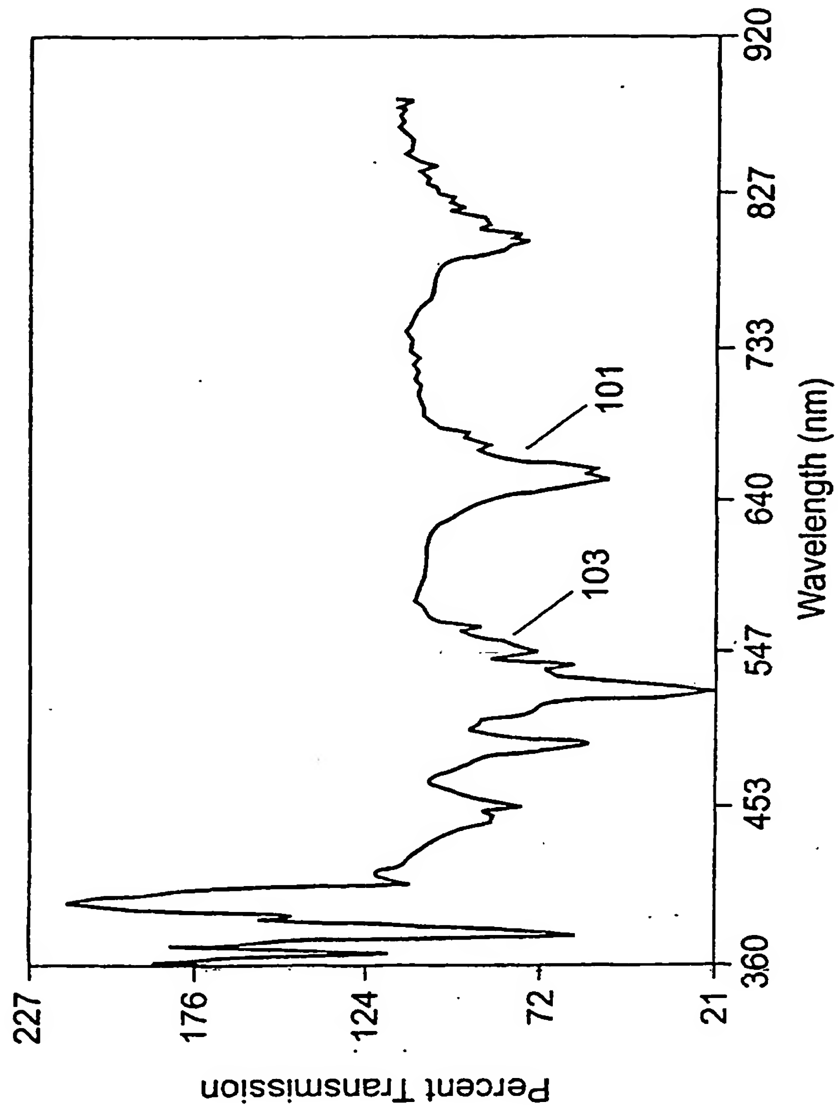
Percent Transmission
227
176
124
72
21
360
453
547
640
733
827
920
Wavelength (nm)
101
103

Fig. 10

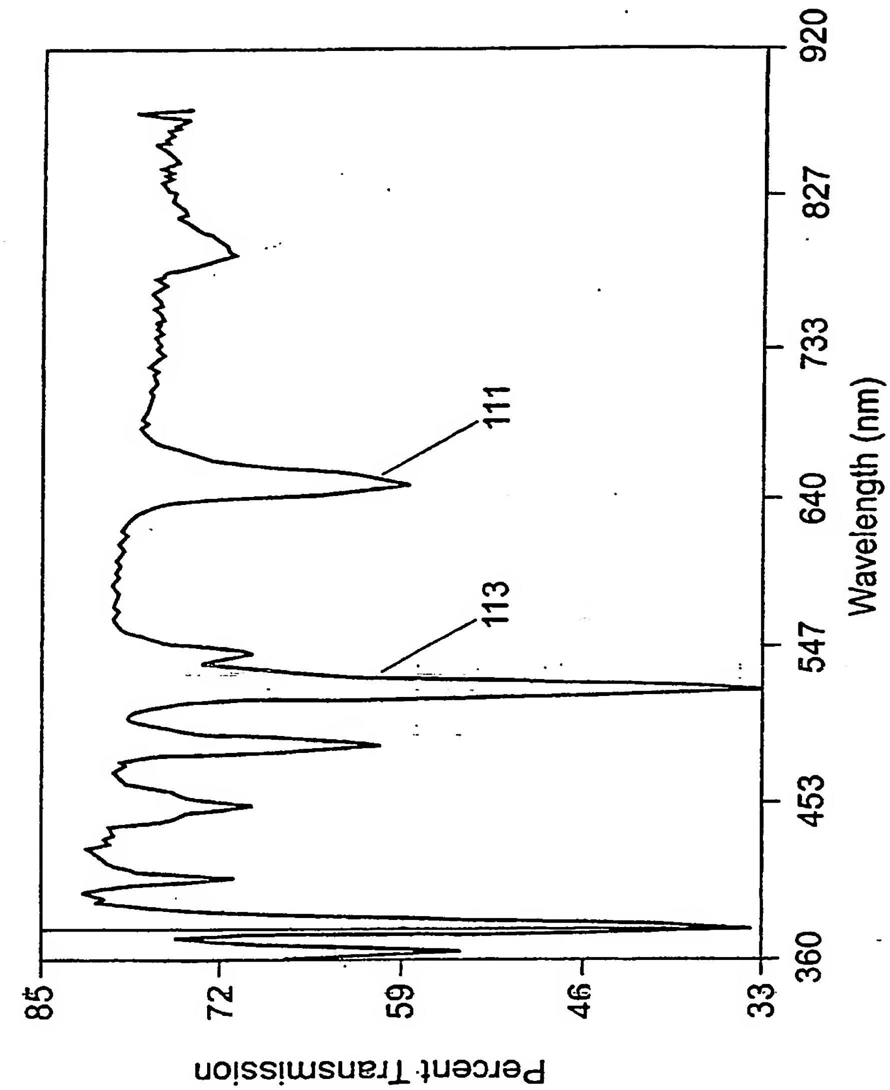
Percent Transmission
85
72
59
46
33
360
453
547
640
733
827
920
Wavelength (nm)
111
113

Fig. 11

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